WHAT IS CLAIMED IS:

1. A method for making an unsupported porous fluorocarbon membrane, the method comprising:

preparing a casting solution including a solvent, a non-solvent and a dissolved fluorocarbon copolymer;

depositing the casting solution on a dense surface to form a membrane;

annealing the membrane at an annealing temperature near a fluorocarbon copolymer glass transition temperature to produce an annealed membrane;

separating the annealed membrane from said dense surface; and

treating the annealed membrane with an ultra-violet (UV)/acrylic process to form the unsupported porous fluorocarbon membrane.

2. The method according to claim 1, wherein said annealing temperature is within the range of about 130°C to 140°C.

3. The method according to claim 1, wherein said dense surface is selected from the group consisting of glass, plexiglass, Mylar (polyester), polypropylene, polyethylene, and polyvinylidine chloride (PVDC).

4. The method according to claim 1, wherein depositing said casting solution includes coating a portion of said dense surface with said casting solution using a knife coating process.

5. The method according to claim 1, wherein said annealing temperature is selected to maximize a tensile strength of the annealed membrane.

6. The method according to claim 1, wherein said solvent is acetone.

7. The method according to claim 1, wherein said non-solvent is one of water and alcohol.

8. The method according to claim 1, wherein said casting solution includes, by weight, 9.5 to12.5% of said fluorocarbon copolymer, 25 to 27% of said non-solvent and 60-64% of said solvent.

9. The method according to claim 1, wherein the UV/acrylic process includes:
applying a monomer solution to said annealed membrane; and
applying energy to said annealed membrane to initiate the creation of free radicals in said annealed membrane.

10. The method according to claim 9, wherein said monomer solution includes an acrylate monomer.

11. The method according to claim 9, wherein applying energy to said annealed membrane includes irradiating said annealed membrane with ultraviolet light.

12. The method according to claim 11, wherein an irradiated surface of said annealed membrane is not in contact with oxygen when said annealed membrane is irradiated with ultraviolet light.

13. The method according to claim 12, wherein said irradiated surface is placed in contact with an airtight film capable of transmitting said ultraviolet light.

14. The method according to claim 11, wherein irradiating said annealed membrane includes focusing energy from an ultraviolet energy source onto an irradiated surface of said annealed membrane.

15. A method for making an unsupported permeable membrane, the method comprising:

preparing a casting solution including a solvent, a non-solvent and a dissolved fluorocarbon copolymer;

depositing the casting solution on a dense surface to form a membrane;

annealing the membrane at an annealing temperature near a polymer glass transition temperature to produce an annealed membrane;

separating the annealed membrane from said dense surface;

applying a monomer solution to said annealed membrane; and

applying energy to said annealed membrane and said monomer solution to initiate creation of free radicals in said annealed membrane and free radicals in said monomer solution, wherein said annealed membrane and said monomer solution react in a polymerizaton process.

16. The method according to claim 15, wherein said annealing temperature is within the range of about 130° C to 140° C.

17. The method according to claim 15, wherein said dense surface is selected from the group consisting of glass, plexiglass, Mylar (polyester), polypropylene, polyethylene, and polyvinylidine chloride (PVDC).

18. The method according to claim 15, wherein depositing said casting solution includes coating a portion of said dense surface with said casting solution using a knife coating process.

19. The method according to claim 15, wherein said annealing temperature is selected to maximize a tensile strength of said annealed membrane.

20. The method according to claim 15, wherein said solvent is acetone.

21. The method according to claim 15, wherein said non-solvent is one of water and alcohol.

22. The method according to claim 15, wherein said casting solution includes, by weight, 9.5 to 12.5% of said fluorocarbon copolymer, 25 to 27% of said non-solvent and 60-64% of said solvent.

23. The method according to claim 15, wherein said monomer solution includes an acrylate monomer.

24. The method according to claim 15, wherein applying energy to said annealed membrane includes irradiating said annealed membrane with ultraviolet light.

25. The method according to claim 24, wherein an irradiated surface of said annealed membrane is not in contact with oxygen when said annealed membrane is irradiated with ultraviolet light.

26. The method according to claim 25, wherein said irradiated surface is placed in contact with an airtight film capable of transmitting said ultraviolet light.

27. The method according to claim 24, wherein irradiating said annealed membrane includes focusing energy from an ultraviolet energy source onto an irradiated surface of said annealed membrane.

28. An annealed hydrophilic unsupported porous fluorocarbon membrane formed by:

dissolving a fluorocarbon polymer, including a tetrafluoroethylene/vinylidene fluoride copolymer, in a heated solvent, mixing a resultant copolymer solution with a precipitating mixture to produce a heated casting solution, the heated casting solution comprising a fluorocarbon polymer component including 23-25 weight percent tetrafluoroethylene and 75-77 weight percent vinylidene fluoride;

depositing said heated casting solution on a non-porous surface to form a deposited casting solution;

annealing the deposited casting solution at an annealing temperature near a polymer glass transition temperature to produce an annealed membrane;

separating the annealed membrane from said non-porous surface to form an annealed unsupported membrane; and

treating the annealed unsupported membrane with an ultra-violet (UV)/acrylic process to form an annealed hydrophilic unsupported porous fluorocarbon membrane.

29. The annealed hydrophilic unsupported porous fluorocarbon membrane of claim 28, wherein said membrane contains, as the fluorocarbon polymer, the mixture of polymers comprised of at least 85.0 weight percent tetrafluoroethylene/vinylidene fluoride copolymer and a fluorocarbon polymer selected from the group consisting of polyvinylidene fluoride, vinylidene fluoride/trifluorochloroethylene copolymer and hexafluoropropylene/vinylidene fluoride copolymer.

30. The annealed hydrophilic unsupported porous fluorocarbon membrane of claim 28, wherein said annealing temperature is within the range of about 130°C to 140°C.

31. The annealed hydrophilic unsupported porous fluorocarbon membrane of claim 28, wherein said non-porous surface is composed of one of glass and Mylar.

32. The annealed hydrophilic unsupported porous fluorocarbon membrane of claim 28, wherein depositing said casting solution includes coating a portion of said non-porous surface with said casting solution using a knife coating process.

33. The annealed hydrophilic unsupported porous fluorocarbon membrane of claim 28, wherein said annealing temperature is selected to maximize a tensile strength of the annealed membrane.

34. The annealed hydrophilic unsupported porous fluorocarbon membrane of claim 28, wherein said solvent is acetone.

35. The annealed hydrophilic unsupported porous fluorocarbon membrane of claim 28, wherein said non-solvent is one of water and alcohol.

36. The hydrophilic unsupported porous fluorocarbon membrane of claim 28, wherein said casting solution includes, by weight, 9.5 to12.5% of said fluorocarbon copolymer, 25 to 27% of said non-solvent and 60-64% of said solvent.

37. The annealed hydrophilic unsupported porous fluorocarbon membrane of claim 28, wherein the UV/acrylic process includes:

applying a monomer solution to said annealed unsupported membrane; and

applying energy to said annealed unsupported membrane to initiate the creation of free radicals in said annealed unsupported membrane.

38. The annealed hydrophilic unsupported porous fluorocarbon membrane of claim 28, wherein said monomer solution includes an acrylate monomer.

39. The annealed hydrophilic unsupported porous fluorocarbon membrane of claim 37, wherein applying energy to said annealed unsupported membrane includes irradiating said annealed unsupported membrane with ultraviolet light.

40. The annealed hydrophilic unsupported porous fluorocarbon membrane of claim 39, wherein an irradiated surface of said annealed unsupported membrane not in contact with oxygen when said annealed unsupported membrane is irradiated with ultraviolet light.

41. The annealed hydrophilic unsupported porous fluorocarbon membrane of claim 40, wherein said irradiated surface is placed in contact with an airtight film capable of transmitting said ultraviolet light.

42. The annealed hydrophilic unsupported porous fluorocarbon membrane of claim 39, wherein irradiating said annealed unsupported membrane includes focusing energy from an ultraviolet energy source onto an irradiated surface of said annealed unsupported membrane.

43. The annealed hydrophilic unsupported porous fluorocarbon membrane of claim 28, wherein the copolymer content in solution is in the amount of 0.01 g/cm^3, and having the ratio of viscosity of the copolymer solution in acetone, to acetone equal to 2.0-4.0

44. A method for producing an annealed hydrophilic unsupported porous fluorocarbon membrane, the method comprising:

dissolving a fluorocarbon polymer, including 23-25 tetrafluoroethylene and 75-77 weight percent vinylidene fluoride copolymer, in a heated solvent, mixing the resultant copolymer solution with a precipitating mixture to produce a casting solution, forming said casting solution into a membrane on a non-porous material;

annealing the membrane at an annealing temperature near a polymer glass transition temperature to produce an annealed membrane;

separating the annealed membrane from said non-porous surface to form an annealed unsupported membrane; and

treating the annealed unsupported membrane with an ultra-violet (UV)/acrylic process to form an annealed hydrophilic unsupported porous fluorocarbon membrane.

45. The method of claim 44, comprising using a ketone as a solvent for the tetrafluoroethylene/vinylidene fluoride copolymer.

46. The method of claim 45, comprising using acetone as the ketone in the amount of 60-70 weight percent of said casting solution comprising from 9.0 to 12.5 weight percent of the fluorocarbon polymer, including the tetrafluoroethylene/vinylidene fluoride copolymer or mixture thereof with other fluorocarbon polymers selected from the group consisting of polyvinylidene fluoride, vinylidene fluoride/trifluorochloroethylene copolymer and hexafluoropropylene/vinylidene fluoride copolymer.

47. The method of claim 44, comprising using a mixture of alcohol and deionized water as a precipitating mixture.

48. The method of claim 44, wherein the alcohol is propyl alcohol or isopropyl alcohol in the amount of at least 14.0 weight percent of said casting solution containing at least 5.0 weight percent of deionized water.

49. The method of claim 44, comprising effecting dissolving of tetrafluoroethylene/vinylidene fluoride copolymer at the temperatures ranging from 30 ° C to 50 ° C.

50. The method of claim 44, comprising, in the course of mixing a copolymer solution with a precipitating mixture maintaining a difference in temperatures thereof at 3 ° C max.

51. The method of claim 44, comprising maintaining temperature of the casting solution applied onto said non-porous material within the range of 25 ° C - 45 ° C.

52. The method of claim 44, comprising storing by a short-term storage of the non-porous material while applying the casting solution occurs under the conditions of free evaporation of a portion of solvent for partial hardening of the casting solution and consequent drying of the membrane, wherein the storing is effected in at least three successive drying zones wherein temperature, increasing from one zone to another, is maintained.

53. The method of claim 52, comprising performing the short-storage for partial hardening of the casting solution at 18 ° C - 25 ° C for about 0.5-1.0 min.

54. The method of claim 53, comprising maintaining temperatures within the drying zones within the following ranges:

first zone--ranging from 45 ° C to 55 ° C
second zone--from 55 ° C to 65 ° C
third zone--from 90 ° C to 100 ° C

and absolute humidity in each drying zone is maintained at the level of not more than 5.0 g/m^3.

55. The method of claim 44, wherein the UV/acrylic process includes:

applying a monomer solution to said annealed unsupported membrane; and

applying energy to said annealed unsupported membrane to initiate the creation of free radicals in said annealed unsupported membrane.

56. The method of claim 55, wherein said monomer solution includes an acrylate monomer.

57. The method of claim 55, wherein applying energy to said annealed unsupported membrane includes irradiating said annealed unsupported membrane with ultraviolet light.

58. The method of claim 55, wherein an irradiated surface of said annealed unsupported membrane is not in contact with oxygen when said annealed unsupported membrane is irradiated with ultraviolet light.

59. The method of claim 55, wherein said irradiated surface is placed in contact with an airtight film capable of transmitting said ultraviolet light.

60. The method of claim 55, wherein irradiating said annealed unsupported membrane includes focusing energy from an ultraviolet energy source onto an irradiated surface of said annealed unsupported membrane.

61. The method of claim 44, wherein the copolymer content in solution is in the amount of 0.01 g/cm^3, and having the ratio of viscosity of the copolymer solution in acetone, to acetone equal to 2.0-4.0.

62. A cartridge filter comprising:

a protective guard;

a perforated hollow core;

a pair of end caps; and

a pleated annealed hydrophilic unsupported porous fluorocarbon membrane placed between said protective guard and said perforated hollow core and in contact with said end caps.

63. The cartridge filter of claim 62, wherein the pleated annealed hydrophilic unsupported porous fluorocarbon membrane is in contact with a support layer and a drainage layer.

64. The cartridge filter of claim 63, wherein said filter includes two pleated annealed hydrophilic unsupported porous fluorocarbon membranes superimposed so that a pleated annealed hydrophilic unsupported porous fluorocarbon membrane closer to the support layer has a pore size ranging from 0.2 to 0.8 microns and a second pleated annealed hydrophilic unsupported porous fluorocarbon membrane has a pore size ranging from 0.04-0.45 microns.

65. The cartridge filter of claim 63, wherein said filter includes two pleated annealed hydrophilic unsupported porous fluorocarbon membranes superimposed such that active surfaces of said pleated annealed hydrophilic unsupported porous fluorocarbon membranes are directed towards the support layer.

66. A cartridge filter comprising:

an inlet;

an outlet;

a housing; and

at least one annealed hydrophilic unsupported porous fluorocarbon membrane.

67. The cartridge filter of claim 66, wherein said filter includes at least one annealed hydrophilic unsupported porous fluorocarbon membrane formed as a flat sheet.

68. The cartridge filter of claim 66, wherein said filter includes at least one annealed hydrophilic unsupported porous fluorocarbon membrane formed as a flat disc.

69. The cartridge filter of claim 68, wherein flat discs are laminated together to form a disk module.

70. The cartridge filter of claim 68, wherein the disc module includes two annealed hydrophilic unsupported porous fluorocarbon membrane discs with a drainage layer in between.

71. The cartridge filter of claim 70, wherein disk modules are stacked one on top of another and contained in a guard.